Sydney Earth and after: Mineralogy of colonial Australia 1788-1900

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VALLANCE, T. G. Sydney Earth and after: mineralogy of colonial Australia 1788-1900. *Proc. Linn. Soc. N.S.W.* 108 (3) (1985) 1986: 149-181.

Like Sydney Earth — the clay once supposed to contain a new chemical element, its custodian in London, Sir Joseph Banks, did little for Australian mineralogy. Banks, in fact, was no complete Linnaean naturalist and his regard for minerals barely passed the useful and exploitative. And in influential British circles of his time Banks was not thought eccentric. Concern for Australian minerals had to arise slowly as exploration and settlement of the country progressed, and as interest was fostered in no small measure by non-British newcomers. When, after 1851, the wealth generated by gold allowed establishment of centres for higher learning and research, the first significant local work in mineralogy was that in Melbourne of the German-trained G. H. F. Ulrich. With his departure to New Zealand, the focus of mineral studies shifted to Sydney and domination by the British-trained chemist A. Liversidge. While the change brought no diminution in the pace of contributions to what once was called mineral geography it certainly involved an eclipse of those aspects of non-chemical mineralogy of which Ulrich was master.

Nothing from colonial Australia seriously influenced the course of mineral science. Effort here had first to be devoted to local exploration and discovery, to diagnosis and census. Australian circumstances dictated the style. Yet by 1901 when the several Australian colonies became one nation the country had already yielded to science no fewer than thirteen new mineral species that are still deemed valid. And eleven of that tally were first recognized as novel by workers in Australia. For a country all but unknown to Europeans in 1788 it is a not unimpressive record, and one that shows the British colonies had wider cultural debts.

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INTRODUCTION

At the time advances in chemistry and crystallography in Europe were beginning to set the study of minerals on a course away from natural history towards physical science, even the coastal limits of Australia remained imperfectly known. The very whereabouts of the continent's eastern shores emerged just two years before J. B. L. Romé de l'Isle [1736-1790], in his *Essai de Cristallographie* (1772), started to define geometrically various arrangements of crystal face forms, and by so doing showed how Linnaeus's qualitative observations of crystals could be developed. Romé saw the geometry of face patterns as a main characteristic of crystals and, thinking of natural crystals, prefaced his book with a passage from *De Re Metallica* of Christoph Entzelt (Encelius) [1517-1583] about the marvels that nature, by geometry, wrought within the earth. But while Romé, his younger rival R. J. Haüy [1743-1822] and their followers in Europe were exploring the geometry of nature, nature's challenge in Australia (or New Holland as it was then called) continued to be one chiefly of geography.

It might have been otherwise. Since Entzelt's time a notion persisted that all southern lands held mineral treasures. A Dutch document of 1622 (Jack, 1921: 30) reveals that samples of gold, silver, copper and lead were taken to New Holland in the hope they would be recognized by the inhabitants and local sources revealed. William Dampier [1651-1715] recalled the thought in 1699 (Dampier, 1703: 138) but saw only sand and nondescript rocks, which presumably he left unsampled. Had Dampier taken specimens they, like his plants, would have gone to the physician and naturalist John Woodward [1655-1728] who in 1710 gave his herbarium to William Sherard [1658/9-1728]. Dampier's plants remain in the Sherardian collection at Oxford (Clokie, 1964: 63). By contrast, the mineral cabinet Woodward bequeathed to Cambridge appears to owe nothing to Dampier and New Holland. In fact, apart from the suspicion of a Dutch crew in 1756 (Jack, 1921: 81) that natives of the Gulf of Carpentaria were familiar with gold, a suspicion left unpursued, there is no evidence any early European visitor to the country had his hope of finding minerals increased. Most travellers no doubt came upon barren places, but not all did.

Having discovered and reconnoitred the east coast of Australia, James Cook [1728-1779] on 22 August 1770 landed with his naturalists on a small island off Cape York. He called it Possession Island, for there he claimed British sovereignty over that tract he had named New South Wales. Cook then sailed on, unaware the flag he saluted had stood next to an auriferous quartz vein. Between 1897 and 1901 that vein would yield 2480 ounces of gold (Jack, 1921: 660). The *Hints* (Beaglehole, 1955: 514-519) of the president of the Royal Society concerning points of natural history to be watched for during the *Endeavour* voyage had been overlooked at Possession Island: 'It has been alledged by some Naturalists that Gold is not found in Veins, as other Metals. If that, or any other Metal should be met with, it would be curious and Instructive, to examine minutely how they lye in the Earth in their Brute State, and how the Veines *Hade*, as well with respect to the angle of their declivity, as their bearing on the Mariners Compass'. It was, however, no isolated lapse at Possession Island. Cook's naturalists, Joseph Banks [1744-1820] and Daniel Solander [1736-1782], had consistently passed over the president's hints about minerals. There are no observations, let alone collections, of rocks and minerals to stand with the wealth of material relating to the animal and vegetable kingdoms as souvenirs of the *Endeavour* voyage.

Rocks indeed did travel on *Endeavour*, as ballast. Specimens of basalt from Raiatea and schist from Ship Cove, Queen Charlotte's Sound, New Zealand, have been retrieved in recent years from the sea floor off Queensland where Cook lightened ship after striking a coral reef. Such material had a use, but not to the naturalists. As a gloss one notes that vesicular basalt taken from Iceland during Banks's visit of 1772 ended up supporting a moss garden at Kew (Faujas de Saint Fond, 1797: 97). There was, however, a mineralogical dimension to that Icelandic venture. The Swedish priest and later archbishop of Uppsala, Uno von Troil [1746-1803], who accompanied Banks and Solander there took an interest in such nature. His account of Iceland (Troil, 1780), supplemented as it is with remarks by Torbern Bergman [1735-1784], makes one regret a person like-minded had not sailed on *Endeavour*.

Banks's involvement with Cook's first voyage to the Pacific may have been prompted by Linnaeus and his writings (Smith, 1821: 231) but if so the influence at best was incomplete. From the first edition (1735) of *Systema Naturae* Linnaeus had sought to systematize the productions of all three kingdoms of nature. Natural order among mineral substances however troubled him, as the disclaimer of 1768 prefacing remarks on *Regnum Lapideum* clearly shows: '*Lithologia mihi cristas non eriget*' (Linnaeus, 1770: 3). Nevertheless, his approach was careful and perceptive (cf. Sjögren, 1909). Carl Linnaeus [1707-1778] could admit his natural history method alone, that based on observation of visible characters and applied with some success to the ordering of plants and animals, yielded no comparably-adequate system for stones and their constituents. Linnaeus recognized that the student of minerals needed aptitudes beyond those of the natural historian, in chemistry, in physics and in mathematics. It was a view destined to be confirmed as mineral science took shape (cf. Greene and Burke, 1978: 1-16). Further, the distinction between simple and compound minerals admitted by Linnaeus and others would be set with the rise of geology. Compound minerals (rocks) became stuff for geologists; mineralogists were free to concentrate on the study of mineral species. Despite his unaccustomed modesty, Linnaeus on the mineral kingdom was a shrewd and prophetic guide. That guidance, it seems, was lost on Banks.

The student of plants and animals had a more straightforward approach. As a rule his material could be gathered with no great difficulty and identified by reference to known samples or to descriptions, many of them illustrated. Illustration remains an invaluable source for the biological taxonomist. There is no such continuing tradition for minerals. The appearance of one specimen offers no certain guide to recognition of others of the same mineral species. Again, to the diverse mastery required of the serious student of minerals must be added the particular effort involved in acquiring specimens, not only the effort of digging and clearing, but in some places also that of competing against those who would turn the material to the service of art or industry. Banks's interest in nature lay with the obvious and the accessible. As president of the Royal Society of London from the year of Linnaeus's death until his own, Banks numbered mineralogists among his associates, and acquired works on the subject for his library, but where is the evidence his concern for minerals went much beyond the practical? He was, after all, a mine owner. The once-famous Gregory lead mine, long a source of income to him, became almost entirely Banks's property in 1792 by inheritance from an uncle of estates near Ashover, Derbyshire. Banks was no complete disciple of Linnaeus but as he paid for the natural history effort on H.M.S. *Endeavour* he also called the tune. Solander, though trained by Linnaeus and no stranger to minerals, accordingly reserved his attention on the voyage for plants and animals, with impressive results.

Indeed, the less-than-Linnaean comprehensiveness of *Endeavour* natural history is easily overlooked in the face of its rich store of biological observation. What matters here is that the partiality then expressed by Banks continued to influence attitudes to Australian nature. When eventually the British government looked to colonizing New South Wales Banks, by virtue of his experience with Cook as well as his office and social standing, became its unquestioned adviser. The record of the early years of settlement shows how zealously Banks performed that unofficial duty. It also shows how concern about minerals in the new territory, unlike that for plants and animals, had to arise within the context of practical value rather than science.

A Penal Settlement and Ill-favoured Nature

Those in England who claimed, in the hearing of Watkin Tench [1758?-1833], that 'the discovery of mines was one of the secondary objects' (Tench, 1789: 121) for settling New South Wales must have been dreaming. Certainly, the prospect of finding 'metals of all kinds' (Barton, 1889: 430) had been urged as a reason for occupying the country but there is no evidence officialdom in London was impressed. In any case the British then regarded commercial exploitation of minerals as the prerogative of private capital whereas the colony resolved to be fixed in New South Wales was to be a government establishment for transported convicts under military guard. Royal instructions (Barton, 1889: 481-487) to the founding governor, Arthur Phillip [1738-1814], dwelt on the need to maintain order and security and to promote agriculture; there is nothing in them about mines or minerals. The governor's main task would be to survive. How he and his people managed was up to them. That they did owed little to any information about the country Phillip brought with him from England.

Banks's choice of Botany Bay, the abode of plants that excited him in 1770 when there with Cook, as the place to settle proved quite unsuitable. Forced to look elsewhere, Phillip happened upon Port Jackson, named but not examined by Cook, and within that harbour selected the place he called Sydney Cove. An advance party was already clearing space for tents there on 26 January 1788 when the governor proclaimed foundation of the colony and publicly wished it success. Routine survey of the port and its vicinity began as the convict transports moved from Botany Bay but the governor had no one on his staff who could make expert investigation of the land. Cultivation of the seeds and plants brought with the fleet was left to convicts working patches of soil among rocky outcrops. More than one of the officers, however, soon discovered an instinct for the more obvious branches of natural history. Their letters and journals are generously provided with observations of native plants and animals, not least of the human variety. Many made sure Banks remembered them, by keeping him supplied with notes, drawings and even specimens. Interestingly, few seemed to take any notice of minerals or rocks. Like agriculture, mineral substances tended to be left to the attention of convicts.

Writing to his secretary of state on 28 September 1788 (*Hist. Rec. N.S.W.* I(2): 190) Phillip observed: 'This country is supposed to have mines of iron and tin or silver by those who have been used to work in mines. . . . A convict, used to work in the Staffordshire lead mines, says the ground we are now clearing contains a large quantity of that metal; and copper is supposed to be under some rocks which have been blown in sinking a cellar for spirits'. But, as Phillip added: 'I give no encouragement to search after what, if found in our present situation would be the greatest evil that could befal the settlement'. The view was understandable; only a month before one of the convicts had fraudulently claimed to have found a gold mine (i.e. deposit). Clearly there was talk of minerals about the settlement, most of it no doubt uninformed but intriguing enough to make Tench (1789: 122) regret 'that some one capable of throwing a better light on it, is not in the colony'. In fairness also to Phillip it must be remarked that his attitude to mineral materials was not uniformly bleak.

The exploring expedition led by J. F. G. de La Pérouse [1741-1788] anchored at Botany Bay on the day Phillip was at Sydney Cove launching his colony; it remained in the bay six weeks before sailing off to a disastrous end. During the stay Phillip came to know various members of La Pérouse's scientific staff, among them the young priest J. A. Mongez [1751-1788]. Mongez had some reputation as an authority on physical and agricultural subjects and, until his departure from France in 1785, assisted his uncle François Rozier [1734-1793] editing the *Journal de Physique* or its antecedent. Mongez had also translated and edited the French version (1784) of Torbern Bergman's *Sciagraphia Regni Mineralis* (1782). His were talents beyond any at Phillip's disposal. Yet this Frenchman, the first person with recognized mineralogical expertise to visit Australia, left a memento of his stay. In the letter of 28 September 1788 mentioned earlier, Phillip reported that 'the Abbé that came out with Monsieur Perouse as a naturalist'*, had told him the white clay used by the natives for body paint and found in abundance about Sydney 'would make good china'. The governor went on (*Hist. Rec. N.S.W.* I(2): 190): 'Specimens [of the clay] were sent to Sir Joseph Banks, and a stone taken out of a slate quarry that I thought contained some metal'.†

* One notes, and rejects, the identification by Lawson (1971: 17) of Phillip's 'Abbé' as Louis [Laurent?] Receveur whose duty on *Astrolabe* as chaplain and naturalist with responsibility for 'analizing and examining minerals' (Milet Mureau, 1798: I, 6) matched that of Mongez on *Boussole*. Receveur was wounded in a skirmish with natives at Tutuila and died of his injuries at Botany Bay on 17 February 1788. Only the scientifically more distinguished Mongez was fit for work in New South Wales. His name could have slipped Phillip's memory. Receveur's, on the other hand, would more likely have been remembered, for the governor in April 1788 ordered erection of an inscribed name plate over the naturalist's grave.

† It is surely remarkable that not one of the letters written from Sydney by Phillip to Banks is recorded in the census of Banks correspondence in British collections (Dawson, 1958, and suppl.). No letters of Banks in reply to Phillip in Sydney seem to be known anywhere. Phillip to Banks letters in the Mitchell and Dixson

The stone was heard of no more. Presumably a shale (there is no slate for quarrying near Sydney), the 'metal' was most likely an iron sulphide mineral. Banks must have thought it not worth attention. With the clay, however, went a request that it be submitted to a ceramist and there Banks obliged, giving a portion to the potter-chemist Josiah Wedgwood [1730-1795]. Examples remain of the medallion Wedgwood successfully made from the clay but greater interest here lies in his chemical study. Wedgwood (1790) reported, for instance, that aqueous dilution of hydrochloric acid in which the clay had been digested yielded an insoluble white precipitate. The response was quite unlike that observed with common china clay and led Wedgwood to claim discovery of a new 'earth', a new chemical element he named Sydney Earth or Sydneia (Sidneia) after its source. J. F. Blumenbach [1752-1840] of Göttingen repeated the experiment on another part from Banks's stock, and while not achieving such a striking result as Wedgwood felt able to confirm his claim (Blumenbach, 1791).

With no great interest in the clay himself, Banks continued to dispense portions to interested inquirers. Thus the Viennese mineralogist Karl Haidinger [1756-1797] got some when he called on Banks in 1795, and gave it to the chemist Martin Klaproth [1743-1817] in Berlin. When Klaproth (1797: 66-69) announced his failure to repeat Wedgwood's result he was attacked by the dead potter's friend William Nicholson [1753-1815] who suggested Klaproth's sample was somehow not genuine (Nicholson, 1797). However not even Nicholson could object after Charles Hatchett [1765-1847], using material directly from Banks, demonstrated the Sydney clay behaved as Klaproth had reported (Hatchett, 1798). It was clear, Hatchett argued, that Wedgwood had been led into error by using 'the common acids of the shops, without having previously examined and purified them'. Vallance (1975: 19) has suggested the offending contaminant was bismuth. The business of Sydneia was an aberration, begun with no more than practical intention and developed through the unfortunate, but not entirely inappropriate, use of a commercial reagent. Science became involved by accident. In a way it also profited. As Hatchett showed, the Sydney clay was the 'common [hydrous] silicate of alumina' with some admixed iron oxide and graphite. On his evidence Hatchett might have called the silicate kaolin, the term from China already used in English and, as kaolinite, still applied to a valid mineral species. But Hatchett left his contribution to Australian mineralogy undefined. He had succeeded in setting straight the chemical record; the nature and source of the clay were of no great moment to him.

During its brief floruit Sydneia gained wide notice in scientific literature. It even raised thought of mineral nature in Australia having a novelty to match those of the plants and animals. Yet strangely the thought seems not to have prompted activity. Other mineralogical specimens sent to London by governor Phillip disappeared without trace. Did their ordinariness curtail the thought of novelty even before Sydneia was demolished? The mineral kingdom in Australia remained ill-favoured, of some use to the colony for building material but little else. Clay was being made into bricks long before the result of Wedgwood's ceramic tests became known. The need for mortar led to search for limestone, without success (Tench, 1793: 164); convicts had to continue gathering shells by the shore. Tench might deplore the lack of expertise in the colony but, in fairness, no expert would have done better in that search. The area about the settlement held no particular mineral riches. Interesting discoveries had to wait until

collections, Sydney, indicate that in fact a wide variety of geological specimens were sent at different times to Banks and that some, at least, of the clay samples came not from Sydney but from an island (presumably Lion Island) at the mouth of the Hawkesbury River. This latter point was reported in print in an article 'Sydney Pottery. By M.L.' in *The Sydney Morning Herald*, 24 Sept. 1927. 'M.L.' also had no doubt Phillip's adviser was the 'Abbé Monges'.

more of the country was examined, and examined by people able to make informed observations. Not surprisingly, the lead such as it was came from exploring expeditions that happened to call.

In the account of his visit to King George's Sound, Western Australia, in 1791 George Vancouver [1757-1798] introduced some remarkable discussion about a chalky substance found there and which from tests with acids and blowpipe as well as optical examination was deemed to 'resemble an earth described in Cronstadt's Mineralogy at the bottom of his note (y), page 21' (Vancouver, 1798: I, 50). One wonders how many of Vancouver's readers, then or since, have penetrated the passage. He refers to Cronstedt (1788: I, 21) and discussion of a 'white earth' from 'the province of Smoland in Sweden' that would now be termed earthy gypsum. For an explorer in Australia this was a piece of quite unexpected sophistication and, although Vancouver gives no acknowledgement, there can be little doubt he was reporting the work of his naturalist Archibald Menzies [1754-1842]. Menzies evidentally had a copy of Cronstedt with him, and knew how to use it. Furthermore, this was no isolated instance of Menzies' attention to minerals during the voyage. His Australian material may be lost but the Chilean collection remains, donated by Menzies to the British Museum in 1800. Remembered chiefly as a botanist, and one described recently (Vancouver, 1984: I, 31) as 'very much Banks' man', Menzies enjoyed what I like to think of as a Scottish breadth towards nature. He had learned his botany in Edinburgh from John Hope [1725-1786], whose successor in the botanical chair was the discoverer of nitrogen Daniel Rutherford [1749-1819], and whose son the chemist T. C. Hope [1766-1844] did much in the 1790s to clarify the nature of barium and strontium minerals. Scots at the time ordered their scientific education with greater rigour and comprehensiveness than the English, more in line with the style of continental Europeans.

The Spanish expedition led by the Italian-born Alessandro (Alejandro) Malaspina di Mulazzo [1754-1809] that visited Port Jackson for a month in 1793 (*Hist. Rec. N.S.W.* II: 24-25) in fact represented a nation with an established system of training in mineralogy and mining under royal patronage (Lopez de Azcona and Sampelayo, 1974). Elsewhere during the voyage (1789-94) such matters had been attended to but in Sydney, the only Australian port of call, the expedition naturalists seemed more intent on botany and social observation. That at least is the impression gained from an incomplete record. The expedition clearly ended in some confusion. Malaspina, in disgrace, spent years imprisoned. His journal of the voyage lay unpublished until 1885 (Aurousseau, 1971) and, at least in Australia, is still little known. A. J. Cavanilles [1745-1804], though not of the expedition, rescued some of the scientific results but even his general paper (Cavanilles, 1799) on the terrain, soils, plants and aborigines about Port Jackson and Botany Bay is rarely noticed. Louis (Luis) Née [fl. 1780-1803], the one naturalist to return to Spain with the expedition, published nothing after a description of the Majon volcano (1803) in the Philippines. Interest seems to have lapsed with Cavanilles' final illness. Kelly (1965), however, points to a wealth of unpublished material, much of it botanical, still in Spanish archives. Of Malaspina's naturalists, Antonio de Pineda died in the Philippines in 1792 and Née's companion at Port Jackson, Thaddäus Haenke (Tadeo Heenke in the Spanish record) [1761-1817], left the expedition to settle in South America. Haenke there acquired property, including a silver mine, and devoted time to writing on botany and mineral resources. Many of his works dealing with South America have been published in the present century. One wonders if anything on New South Wales by this most geological of Malaspina's scientists is preserved in his adopted home Bolivia.

Problems also beset the French expedition under A. R. J. de Bruni d'Entrecasteaux [1739-1793] that visited Australian waters between 1792 and 1794, problems arising from political turmoil in France and from war with Great Britain. The expedition had been sent out in an attempt to discover the fate of La Pérouse and, like his venture, to enlarge scientific and geographical knowledge. Of the five naturalists assigned to the ships under d'Entrecasteaux's command, four might best be described as botanists though C. A. G. Riche [1762-1797], former secretary of the *Société Philomatique* in Paris, had broad interests in natural history as did the best-known of them, J. J. H. de La Billardière [1755-1834]. The fifth, Jean Blavier [1764-1828], went as mineralogist. His appointment, like those of Mongez and Receveur with La Pérouse, underlined the breadth of French perceptions of natural history. Australia, however, was denied Blavier's inspection. Taken ill at Cape Town, he had to withdraw on the outward voyage. Consideration of rocks and minerals became an added duty for the botanists and to it La Billardière, at least, responded positively. Take for instance that day in February 1793 when coal seams were found inland from South Cape, Tasmania (then Van Diemens Land). From the vicinity of the coal La Billardière (1799: II, 22) noted pieces of 'bronze-red' hematite as well as red ochry earth and 'tripoli'. The last was probably a clay, not diatomaceous earth, but otherwise the statement is persuasive. However, neither these nor any other minerals observed on the voyage received detailed study. There may indeed have been little chance for later work on them for, as Hulot (1894: 134) remarked with fine understatement, many of the expedition's mineral samples 'went astray'. Conflict between naval officers and the citizen scientists brought the expedition to a shambles. De Beer (1960: 45-68) outlines the sorry story. Eventually, with the help of Banks, La Billardière managed to regain possession of his plants and with them alone make important contribution to Australian science. The mineralogist is left to regard the visits of the d'Entrecasteaux and Malaspina expeditions as having the interest of unfulfilled promise. In fact, the cause of mineral discovery in Australia during the 1790s, at least in terms of information made known, seems to have been better served by the colony's relatively unsophisticated residents.

Some mineral materials are so generally familiar their identification presents no difficulty. Coal is one such; it had been found north of Sydney by runaway convicts in 1791 (Vallance, 1975: 30). 'Ironstone' is another. One does not need La Billardière's knowledge of hematite to recognize it. By 1801 samples of the material from New South Wales had been reduced to metal in England (*Hist. Rec. N.S.W.* IV: 595). Salt, too, could be easily identified. An exploring party in 1798 returned to Sydney with news of 'an immense cliff of salt, a specimen of which they brought in' (Collins, 1802: 88). A revisit, like the first encouraged by governor John Hunter [1737-1821], yielded more samples, some of which were sent to Banks with uncertain result. It is possible Banks informed Robert Jameson [1774-1854] who added the detail to published science (Jameson, 1805: 17) though by then that author as easily could have relied on Collins. Cambage (1920) gives an explanation of what became reputed in mineralogical literature a mountain of rock salt in the interior of New South Wales. At the place Cambage took to be that visited in 1798, a locality near the confluence of the Bargo and Nepean rivers, protected faces of Hawkesbury Sandstone bear incrustrations of sodium chloride.

Collins (1802) reported other points of mineralogical interest, many of them arising from discoveries made after he left the colony in 1796 and for news of which he depended mainly on Hunter. David Collins [1756-1810], officer of marines and sometime deputy judge-advocate in New South Wales, had been secretary to both Phillip and his successor, Hunter, Phillip's second-in-command at the foundation of Sydney. Hunter knew how during Phillip's incumbency the difficult circumstances of settling a community had prevented much effort being devoted to other than local reconnaissance. When he returned to Sydney, as governor, in 1795 he determined to encourage exploration, insofar as his resources would allow. The first of only two governors of New South

Wales in the first fifty years of the colony who had attended a university, Hunter had a genuine interest in promoting knowledge of his territory. It was his good fortune to meet on the voyage back to Sydney two young naval men, Matthew Flinders [1774-1814], then a midshipman, and surgeon George Bass [1771-1803], ready to serve that interest.

In June 1797 Hunter sent Bass to examine and report on coal seams found south of Sydney by survivors of a shipwreck. Bass's remarks on the visit are preserved in a letter of 20 August 1797 (*Hist. Rec. N.S.W.* III: 289-290) to William Paterson [1755-1810]. Hunter must have thought the effort useful. On 1 August 1797 he wrote to Banks (BM(NH) Dawson Turner copies 10(2): 108) urging the need for a systematic investigation to be made of the minerals of New South Wales. No doubt Hunter envisaged such effort in terms of practical results but the contrast with Phillip's attitude just nine years earlier was remarkable. The colony had survived and now, as Hunter saw it, it could be served by knowledge of natural resources, among which minerals offered greater promise of usefulness than the native plants and animals. Banks, however, took no notice of Hunter's request. The governor would have to rely on those in the colony like his young naval friends who, though relatively inexpert, were prepared to take notice of minerals. A nice example of such interest comes from Preservation Island in the Furneaux Group, visited by Bass and Flinders during their exploration (1798-9) of Bass Strait.

Bass's description of the island (Collins, 1802: 147-152) includes notes on rocks and shell-beds, on wood in various stages of fossilization and on accumulations in beach sand of 'black metallic particles which [also] appear in the granite as black shining specks, and are in all probability grains of tin'. Bass also knew, from the mariners whose coal discovery he inspected in 1797 and who had been wrecked on the island, that water there was injurious to health. Accordingly, Bass tested the black particles by heating them in a crucible and noted generation of a 'large fume of what bore marks of arsenic'. Surgeon Bass would have made no mistake in that diagnosis yet he seems not to have wondered why his 'tin' behaved so strangely. 'Tin' (tinstone, or cassiterite) yields no such fume on heating. The seeming confusion, however, did not deter Liversidge (1888: 77) from claiming that Bass indeed found cassiterite, and would have known it 'since he appears to have possessed considerable geological knowledge'. Liversidge's argument falls well short of proof but one notes with interest its endorsement by an author who knew the region (Petterd, 1910: 39). If Bass was the first discoverer of cassiterite in Australia there is even more evidence he came across a common associate of that mineral, the arsenical phase mispickel (arsenopyrite).

To credit Bass thus clearly involves going beyond the record he left. It is possible to do so however because the insufficient mineral diagnostics are in some measure compensated for by facts about locality and occurrence. Apart from the common rock-forming varieties, minerals tend to be more confined in space than plants and animals. No part of the study of nature finds detail of 'where' and 'how' more revealing than that concerning minerals. It is instructive in this regard to contrast Bass at Preservation Island with a near-contemporary work on black beach-sand by a better-known scientist.

Early in 1801 the Irish chemist and mineralogist Richard Chenevix [1774-1830] received from Sir Joseph Banks 'a quantity of sand, which had been found on the sea coast in Providence Island, and thence brought over to England in the course of the winter' (Chenevix, 1801: 132). In addition to quartz and some red grains that Chenevix took to be garnet, the sample contained an abundance of black, slightly magnetic grains of an iron-titanium oxide similar in composition to the mineral reported six years earlier and named menachanite (manachanite, menaccanite and other variant spellings now all subsumed in the later term ilmenite) after its Cornish locality. What was the source of this second sample? 'From Botany Bay' appears in the title to Chenevix's paper which ends with a passage reminiscent of the launching of Sydneia: 'If the mineralogical riches of the country, from which this sand was brought, are at all to be prejudged, from the valuable productions with which we have become acquainted in the vegetable and animal kingdoms, we may look forward to many interesting discoveries'. Yet the locality Providence Island is not Australian. Leonhard (1808: II, 224-225) resolved things to his satisfaction by assigning the mineral to both Providence Island, North America, and to New South Wales (Botany Bay). K. C. von Leonhard [1779-1862], however, gave no authorities, and Chenevix appears to have studied only one batch of sand. Had Banks been slipshod in fixing its provenance? Whatever the cause, Chenevix's hope of encouraging interest in Australia's minerals was nullified. If in fact the sand had come from Australia the confusion is the more extraordinary for at the time Chenevix got it Banks was in closest contact with a man just returned from Sydney, a man who could have brought the material with him.

Soon after he reached London in the latter part of 1800, Flinders made himself known to Banks with a letter outlining what he and Bass had achieved and a plan for a more comprehensive hydrographic and natural history survey of the Australian coasts. He sought Banks's patronage and, perhaps thinking he knew the baronet's inclinations, emphasized the potential for enlarging knowledge of natural history, of which he added 'the mineralogical branch would probably not be the least interesting' (Vallance and Moore, 1982: 3). Flinders must have been quickly disabused; his enthusiasm for minerals was not shared. Otherwise, Banks responded warmly to the plan. Before the end of 1800 a vessel, renamed H.M.S. *Investigator*, had been chosen for an expedition under Flinders' command. In public Flinders chose to be diplomatic. His account of travels with Bass (Flinders, 1801), a work dedicated to Banks, gave scarcely a hint of the explorers' interest in mineral nature. Privately, he kept trying to have a mineralogist appointed (cf. his letter of 24 January 1801 to Banks, *Hist. Rec. N.S.W.* IV: 291), but to no avail. Banks determined the style of the expedition's scientific effort. Although aware the French had recently despatched N. T. Baudin [1754-1803] to Australia with two vessels and a large scientific staff that included two trained mineralogists, Banks resolved that Flinders would be suitably served by one naturalist, and he a botanist. In what may have been a grudging nod to Flinders, the naturalist was allowed the assistance not only of a gardener and a botanical artist but also of a 'practical miner' (Vallance and Moore, 1982: 3-4).

Much has been written about the expeditions to Australia led by Baudin and by Flinders, and in the context of Baudin's venture at least too much of it is confused and contradictory. This is no place to set about major revision but as a step towards clarifying the French provision for science I have gathered in an Appendix a tally, based on scattered sources, of Baudin's naturalists. Baudin, already an experienced commander of scientific expeditions, sailed for Australia with a staff of ten scientists, some veterans of travel with him, who were assigned to the principal divisions of nature. Having arranged the issue of passage documents in case of war, Banks knew what the French had done. His response was to choose as Flinders' sole naturalist an assistant surgeon in the army, Robert Brown [1773-1858], known to have interest in botany but without any experience of long sea voyages. In science the French appeared to hold every advantage. That the appearance became illusion is history not of Banks's making. Defection, rancour, illness, death, each took an awful toll of the Baudin expedition. Careful French planning of the scientific effort provided little defence against human frailty. By contrast Banks, in choosing Brown, chose shrewdly. He wanted a botanist, and got one of distinction. But Brown, like Archibald Menzies before him, had Scottish breadth in his approach to nature. Brown's contribution to Australian mineralogy, for instance, can stand comparison with what is known of the results of Baudin's two mineralogists, Louis Depuch and J. C. Bailly (see Appendix).

Admittedly, the record of work by Depuch and Bailly is incomplete. Among the scientists they seem to have stayed reasonably loyal to their commander whose journal provides glimpses of their activity (Baudin, 1974). Extracts from their notes are given there and in the official record of the expedition (Péron, 1807; Péron and Freycinet, 1816) but the main documentary source is an unpublished detailed catalogue of the rock and mineral collection (transcript in Mitchell Library, Sydney, Baudin Expedition Papers B1265). It describes what seems to be a reasonably representative gathering of what would have been seen at the stopping places along the western and southern coasts of Australia, in Tasmania and in Timor. Not much more than that can be said with confidence; the samples are now lost (Vallance, 1983a: 135-136). One notes, however, impressive agreement between the catalogue diagnoses and the descriptions of selected specimens seen by Leopold von Buch [1774-1853] in Paris during 1810 (Buch, 1814). There is no reason to doubt Depuch and Bailly did their work soundly but apart from Buch and J. A. H. Lucas [1780-1825], who noted such Australian minerals as Depuch's 'arragonite' from Tasmania and the same collector's menachanite sent from Botany Bay (Lucas, 1813: 37, 487), there are few signs the collection drew much interest. Certainly it can have contained no new, rare or valuable materials but that was no good reason for condemning the work of the mineralogists as of little interest (Jussieu, 1804: 7). Decision-makers in Paris might despatch mineralogists on expeditions yet be as uninterested in promoting the science as Banks. At least Banks's partiality was honest.

Until recently what was known of mineralogy and the *Investigator* voyage came from the commander himself. Flinders (1814) provides many instances of such observation, and as study of Brown's notes has advanced it is clear that what Flinders published was largely his own. It is clear also that Flinders took his own mineral samples, and deeply regretted their loss by shipwreck. The same disaster deprived us of much of Brown's rock and mineral collection. Fortunately, one part was not packed and ready when Flinders sailed. It returned to England with Brown in 1805, to be set aside and after some years handed over to the British Museum where its neglect long continued. Vallance and Moore (1982) have restored to order what remains and described the material. With specimens available, assessment of the quality of Brown's mineralogy becomes a far simpler task than that faced with Depuch and Bailly. Brown, too, may have found no new, rare or particularly valuable minerals but clearly he was observant and possessed a good working knowledge of the subject. This writer, having worked through Brown's collection and notes, is especially impressed by the field-identification at Melville Bay, Arnhem Land, of colloform pyrolusite as 'oxyd of manganese?' (Vallance and Moore, 1982: 24). The manganese deposits now exploited in northern Australia had to be rediscovered while Brown's material lay unregarded. But then Brown himself can hardly have been expansive about his thought on manganese; Flinders (1814: II, 224) at the same locality mentions what was surely the same material as ironstone. Brown is justly praised for his Australian botany; had he been more communicative he would have deserved greater credit as a mineralogist.

By coincidence, on the day (16 February 1803) Brown was inspecting his pyrolusite, a man in London was considering the offer of a novel appointment in Australia. Two days later A. W. H. Humphrey [1782?-1829] indicated acceptance of the post of H.M. Mineralogist in New South Wales. Ill-favoured nature had found British royal patronage. Never before, not even in the United Kingdom, had there been a British Crown appointment in mineralogy, and in the colonial establishment of New South Wales only the mineral kingdom would have its official cultivator under royal commission. A remarkable first step had been taken to fix resident concern for minerals in Australia.

MINERALS ACKNOWLEDGED: THE GROWTH OF RESIDENT INTEREST

Humphrey's appointment marked a distinct, and unexpected, shift in British decision-making about Australia, one it need hardly be said that owed nothing to Banks. Indeed why the decision was made to appoint a mineralogist at that particular time remains unclear. Equally unclear is why C. F. Greville [1749-1809] chose then to press the government on the matter. There had been no mineral discovery in Australia to excite public attention and what mineralogical results might stem from the French and British expeditions were still unknown. Perhaps Greville, a man of influence in politics and science like Banks but who was also a noted mineral collector, simply felt the mineral kingdom in Australia had been too long neglected. Whatever the prompt, and no case can be made for Greville's private advantage, his advocacy drew a favourable response from government. Greville seems to have envisaged a prospecting survey, a practical collecting venture rather than one of detailed science. It is not surprising therefore that when authorized to seek a suitable person Greville should turn to the dealers in natural history. Humphrey's links with that trade are outlined elsewhere (Vallance, 1981); to those remarks need be added only the information gleaned by John Currey (in Humphrey, 1984: 26) that Humphrey attended courses in chemistry given by Alexander Crichton [1763-1856] who, in turn, was to supply Greville with a useful testimonial on Humphrey's behalf. Currey's discovery shows Humphrey had experience requisite to use the apparatus with which he was supplied in Australia, and about which he grumbled with good reason (Vallance, 1981: 141).

What is known of Humphrey's career in Australia has been discussed at some length in recent works (Vallance, 1981; Humphrey, 1984). Despite his fine title, Humphrey was little more than a prospector and apart from the period he was in the field with Robert Brown (1803-4) seems to have been not remarkably diligent. His interest to us arises from the office he occupied rather than any particular discoveries. Yet Humphrey's presence in the colony may have been spur to others not previously much given to minerals. Bass's friend Paterson for instance soon after receiving charge of the settlement at Port Dalrymple, Tasmania, ordered his men to collect samples for despatch to Sydney: 'A variety of rare and apparently valuable minerals have been received; among which is the pure asbestos, combined with a ponderous ore, which is found in great abundance' (*Sydney Gazette*, 24 Nov. 1805: 2). Humphrey is known to have worked on some such consignments, and even selected material for despatch to England (Vallance, 1981: 117).

Humphrey had come to Australia in 1803 with the contingent led by David Collins intended to fix a settlement at Port Phillip, but that place being found unsuitable Collins turned to the Derwent estuary in Tasmania and there founded Hobart Town (1804). The extension of settlement brought increased opportunity that in turn drew more free settlers to the country with prospects of land grants and free convict labour. Some of those settlers were men of education able, if willing, to enlarge colonial sophistication. A nice example is Robert Townson [1762-1827], another protégé of Greville but unlike Humphrey already a man of consequence and learning, LL.D. (1796) of Edinburgh and author of several works on travel and science, among them *The Philosophy of Mineralogy* (1798). Vallance and Torrens (1984) give an outline of Townson's European career and the background to his decision to settle in Australia. Townson plainly hoped to continue his scientific activities for which purpose, through Greville's good offices, he obtained £100 for books and apparatus. Unfortunately, Townson found no easy welcome in

Sydney. The governor, William Bligh [1754-1817], seemed in no hurry to oblige and Townson had become a grumbler long before the equally-unacceptable officers who overthrew the governor granted him land. Writing to a friend in England Townson attributed his misfortunes to there being too many in the colony enjoying appointments procured by Banks: 'things will be no better while he has any influence' (H.S. Torrens, pers. comm.). By letter 2 April 1808 (British Library Add. MSS 42071 f.356) he warned Greville: 'you must expect nothing about science from me until I am more at ease — at present I have enough to do to keep myself from destruction'. He had then been in the colony less than a year but one suspects that in his view saving himself from destruction became a continuing diversion. Nevertheless he managed an existence of reasonable comfort in Australia and his candidature (1822) for election to the short-lived Philosophical Society of Australasia (*J. Proc. Roy. Soc. N.S.W.* 55, 1921: cii) shows old interests persisted. Perhaps that late conjunction was appropriate; both Townson and the society are more easily recognized as indicators of an emerging colonial refinement than as contributors to scientific knowledge.

As colonial society became more diversified so also did local industry, some of it dependent on minerals. Brick-making has been noticed. By 1801 coal was being mined by convicts at the Hunter River and shipped to Sydney. In 1812 the then governor, Lachlan Macquarie [1762-1824], accepted Humphrey's resignation as mineralogist. According to Macquarie, Humphrey had found nothing 'Worthy of Notice' but whatever the scale of Humphrey's failure (and it was not unrelieved failure, as Vallance (1981) shows) it did not prevent the governor from seeking a 'scientific mineralogist' by way of replacement. London, however, seemed in no hurry to respond. Macquarie was no longer governor when John Busby [1765-1857] reached Sydney in 1824 to begin duty as civil engineer and mineral surveyor, not as H.M. Mineralogist. Humphrey's post had become extinct and a distinctly more useful orientation fixed. Busby, in fact, would be kept far busier securing Sydney's water supply than prospecting for minerals.

Meanwhile, other industrial ventures emerged. In 1812 newspaper advertisements in Sydney announced locally-made domestic glassware. The effort seems not to have prospered but is of interest through the involvement of a convict, John Hutchison [d. 4 December 1820], recently transported for forgery. Hutchison plainly had influential friends. The Society of Arts, for instance, petitioned Whitehall that 'his general Abilities and chemical Knowledge' be employed in New South Wales in the study of natural products, especially those useful to the dyeing trade (*Hist. Rec. Austr.* I, VII: 541-542). Somewhat reluctantly one suspects governor Macquarie provided Hutchison with apparatus and reagents, and in return received reports of supposed progress (*Hist. Rec. Austr.* I, VIII: 212-235). Their interest to the mineralogist may not be great but included are remarks on tests of mineral pigments, on local clays for earthenware and copperas made 'from Pyrites I had from the Coal [Hunter] River'. The latter must surely rank as the first experiments on sulphide minerals in Australia. However, by March 1814 the governor must have decided the convict's efforts were unrewarding. Hutchison was granted leave to engage in business; his death notice (which confirms the name as here and in Macquarie's correspondence, not Hutchinson as some claim) has him then superintendent of the Lachlan Water Mills (at Botany, near Sydney). Hutchison left no particular mark either on the colony or science, but interestingly not many years later one of his initiatives would be resumed. In 1831 James King [1800-1857], who had come to Sydney of his own accord to set up as a merchant, drew attention to the suitability for glass-making of certain local sands (cf. King, 1833). King, in fact, was to give many leads to colonial industry, notably in ceramics and viticulture. A man of unusual talent, his letter of 1 August 1827 to the physicist David Brewster [1781-1868] supplying details on the climate and geology of New South Wales gained a place in scientific literature

(King, 1828). Brewster (1827), with his optical study of Australian topaz, a mineral of which Humphrey is credited the discoverer (Jameson, 1811), has another claim to notice here (cf. Vallance, 1975: 19).

Completion in 1815 of a road across the rugged Blue Mountains that hitherto had kept settlement at Sydney confined to the coast opened the way for inland exploration of the mainland colony. That desired material limestone had been found west of the mountains by the surveyor G. W. Evans [1780-1852] even before the road was finished. In view of Evans's later work on Tasmania, with its intelligent collection of detail about minerals (Evans, 1822: 58-59), the argument seems strange that he lost leadership of future mainland exploration on account of inadequacy in geology and botany (Weatherburn, 1966: 53). The fact was, for minerals at least and despite growing interest in them, the colony possessed little available sophistication (and Townson plainly was not 'available'). In those terms it seems unjust to have rated Evans deficient. Yet on the 1817 expedition led by J. J. W. M. Oxley [1785?-1828], in which Evans was second-in-command (Oxley, 1820), a convict William Parr held the title 'mineralogist', or 'Acting Mineralogist' as Macquarie styled him in a requisition for reagents 'for making experiments of Ores & metals' (Mitchell Library, Sydney, A763 (Wentworth Papers) 197). Oxley (1820: 375) indeed reported that a small 'mineralogical collection' had been made and that Parr had done 'as much as could be done in that branch' but Parr's expertise was surely limited to that of collector. Parr remains a shadowy figure (records even differ as to whether he was William, S. or T. Parr); Morgan (1958: 189-192) gives a few details. For some reason Parr did not accompany Oxley and Evans on their 1818 exploring journey when rocks and minerals were also collected, presumably by the field botanist and 'Colonial Collector' Charles Fraser [1788?-1831]. Manuscript lists, now in the British Museum (Natural History), of specimens donated to the Geological Society of London bear witness to geological activity by Fraser and by his colleague on Oxley's 1817 venture Allan Cunningham [1791-1839], the eminent collector for the Royal Gardens at Kew. The specimens themselves must be presumed lost.

Other explorers who followed Oxley and his parties into the interior also returned with rock and mineral samples, and no doubt some of them too were sent to London, there to be neglected. But rocks and minerals became incidental; the enthusiasm that set Parr the 'mineralogist' with Oxley would not be repeated in the early days. Even in the colony there could be extraordinary failures in communication, none more than assistant surveyor James McBrien's discovery of particles of gold in sand near the Fish River (Pittman, 1901: 1). Had the news spread in a society still substantially convict there might have been highly disruptive consequences, but the surveyor's notebook with its critical entry for 15 February 1823 lay unregarded until near the end of the century. There is no evidence that McBrien's find was suppressed.

It might be thought that establishment at Sydney in 1827 of a colonial natural history museum, since 1834 the Australian Museum, would have enlarged local interest in minerals by affording colonists access to a reference collection and, in turn, attracting donated specimens. In fact, the first printed catalogue, issued in 1837, lists few minerals of any sort and only one Australian sample. Although early opportunity for mineralogy was lost, it seems appropriate here to anticipate later developments. The Australian Museum employed no one to work on its minerals until 1859 when, briefly, it had the service of J. R. Gygax [1809?-1859].* Not until 1881 did the museum admit that its mineral collection, which by then had a large local component, deserved a curator and

* John Rudolph Gygax, the man off-handedly described by Etheridge (1919: 387) as 'apparently a German of sorts' and mineralogist at the museum during August-October 1859, had an interesting career that deserves notice. Of Herzogenbuchsee, a place between Bern and Zurich in Switzerland, Gygax had medical training but early evinced interest in minerals. During a visit to the Azores in 1838 he found and collected on Fayal the

apppointed the French-born Felix Ratte [1845-1890] to the post (Chalmers, 1979). In earlier days no doubt it was thought simpler, and cheaper, to rely on acquisition of identified material, much of it therefore foreign. Most other museums in Australia, as they came into being, seem to have found that sort of practice attractive. None can be said to have fostered mineralogical study before the emergence of the Industrial and Technological Museum in Melbourne in 1870. It was an appropriate place for innovation; Melbourne itself did not exist when the Sydney museum began.

With negligible help from the Australian Museum, colonial interest in minerals began to prosper during the 1830s. Collections would still be sent overseas and occasionally come to scientific notice, some by unexpected ways. One of the first to receive careful examination, by Francis Alger [1807-1863] in Massachusetts, had been acquired in Calcutta. When Alger (1840) saw the material locality details were already lost; his identifications suggest sources in Tasmania. The merit of Alger's work lies in its descriptive detail; few, if any, Australian minerals had been given that sort of attention before. And, it must be admitted, the time when such work would be done in Australia was still remote. Nevertheless impressive changes had begun. The Australian College, a Presbyterian school then being founded in Sydney, advertised mineralogy as part of its curriculum (*Sydney Herald*, 19 Dec. 1831). A month earlier the school had announced the purchase for its use of the scientific apparatus of Andrew Ure [1778-1857]. Ure had recently relinquished a chair in the Andersonian University, Glasgow, to work in London and presumably no longer needed the equipment. One wonders if Ure also provided the mineral cabinet the school claimed to be importing at this time. Not surprisingly, the school and its plans for instruction in science received useful publicity in the *Herald*; the teacher, John McGarvie [1795-1853], Presbyterian clergyman and Glasgow graduate, was a proprietor of the newspaper. The Scots schoolmaster may have left no record of mineral observation but his role as a communicator is not to be underrated. Nor was McGarvie's an isolated advocacy of science during the 1830s. That decade saw the arrival in Australia of two highly individual characters, Jan (Johann, John) Lhotsky [1795-1866] and Johann Menge [1788-1852]. They too in their different ways were communicators but, unlike McGarvie, they were active searchers after, and students of, minerals. Their experience of minerals likewise had differed, Lhotsky academic and Menge practical, yet both brought to Australia aspects of the continental European tradition. This latter fact, of itself, is significant. As will be shown later, mineral science in the British colonies of Australia really emerged from that tradition.

Born at what was then Lemberg in Austrian Galicia (now the Polish city of Lwow), Lhotsky's ancestry was Bohemian and his education chiefly German in the cultural sense. After studying medicine for a while in Prague he moved to Vienna and then

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unusual mineral (Gygax, 1839) analysed for him by L. R. von Fellenberg [1809-1878]. The substance was named *fayalite* in 1840 by C. G. Gmelin [1792-1860]. By 1846 Gygax was in Ceylon (Sri Lanka) making a mineral survey for the local branch of the Royal Asiatic Society, a work extended under government commission during 1847-8. Apart from official reports, Gygax (1847) gave an outline of the subject he pioneered in Ceylon. He also curated the society's mineral collection and prepared at least one district mineral catalogue later (1855) issued by the society (see also Tennent, 1859: 31-32). It is not known when Gygax left Ceylon. He appears to have been there in August 1850 but lists of the Schweizerische Gesellschaft für gesammten Naturwissenschaften, of which he was a member, suggest residence in Java about 1853. By 1854, he was on the Australian goldfields, at Sofala, from which locality he supplied a collection of rocks and minerals for the Paris Exhibition Commissioners (1854). Though not listed in the N.S.W. medical register, Dr Gygax is known to have practised at Rylstone before removing to Sydney to undergo medical treatment perhaps early in 1859. Although Etheridge attributed Gygax's employment in the Australian Museum to the agency of R. J. Want, a letter of July 1859 in the Macleay Papers, Linnean Society of London, from W. B. Clarke to W. S. Macleay recommends Gygax for service. Gygax died suddenly at his lodgings 3 October 1859. A coroner reported his age as 50 and death by natural causes. As the coroner also heard that Gygax had intended soon to go to New Caledonia for geological work, 50 is taken as a more likely age than the 70 on Gygax's death certificate.

Berlin, becoming increasingly engaged by philosophy and politics. At Jena in 1819 he gained the doctor of philosophy degree. The first clear sign of interest in minerals appears in 1822 when he attended the lectures of A. J. M. Brochant de Villiers [1772-1840] in the Paris *École des Mines*. To those classes and to the tuition of C. F. C. Mohs [1773-1839] in Vienna, where Mohs became professor of mineralogy in 1826, Lhotsky would later ascribe his training in mineralogy (Vallance, 1977: 42). Both Brochant and Mohs had studied under A. G. Werner [1749-1817] at the *Bergakademie*, Freiberg; through them their pupil would become linked to the Wernerian school of thought. But Lhotsky had also developed other links, political links actively disfavoured by the Austrian government. His acquisition of mineralogy in fact was interrupted by imprisonment as a supposedly dangerous radical. He reached Sydney in 1832, a political exile hoping to prosper as a travelling collector of natural history material. By then he had to his credit a paper on the hydrous iron phosphate mineral cacoxenite (Vallance, 1977: 44) in a respected European journal. It may have been essentially a natural history study, without much evidence of crystallographic or chemical mastery, but the quality suffices to show that as a mineralogist in the New South Wales of his time Lhotsky was unrivalled.

In Australia Lhotsky tends to be remembered, if at all, as namer of the Snowy River and for a prophecy that one day a great city would stand at Limestone Plains. Limestone Plains is now occupied by the nation's capital, Canberra. But Lhotsky not only travelled about, he left an unfinished account (Lhotsky, 1835) of his journey to the Australian Alps that contains much on all branches of natural history, he collected and dealt in specimens, he gave public lectures on mineralogy, botany and zoology, and, withal, antagonized the establishment. Rebuffs seemed in no way to damage his self-esteem, as can be seen from his prospectus of a company (The Australian Mine Exploring Company) he hoped to float (*Sydney Monitor*, 8 August 1833): 'Dr. Lhotsky will ever remain of the opinion that he was the first person in this Colony who, by his lectures on Mineralogy and Geology, and by his travels and collections, raised and excited the interests of our community upon these highly interesting and important sciences . . . His lectures, his voyages and his collections (which last by the kind communications of many friends of science, are the general Repository of all minerals ever collected in the Country,) have thoroughly refuted the inveterate prejudice, that Australia is poor in Mineralogical productions, that it is altogether deficient in precious metals: as even with Dr. L.'s small means, he has found the vestiges of some of these.' In 1860 Lhotsky was to claim reward as a gold-finder (Vallance, 1977: 53); it had no more success than the prospecting venture, and perhaps failed for much the same reason. Lhotsky lacked powerful friends.

For a time in Sydney Lhotsky conducted the natural history section of a local magazine. The essay 'Mineralogy of Australia' (*New South Wales Magazine*, I(1), August 1833: 43-45), prepared in that office, is an interesting work. Much of it, certainly, is borrowed from earlier German sources but the geographical list of Australian minerals depends on closer knowledge. This list, the first of its kind to appear in Australia, is in my view a statement of Lhotsky's experience (Vallance, 1977: 46). It makes one regret the man had so little support in the colony. He moved to Hobart in 1836. Two years later he was in London, still hoping to improve human knowledge and society; he died there still an exile.

One of the lesser-known founders of the colony of South Australia, Johann Menge, like Lhotsky, was both idealist and enthusiast. Interest in minerals was shared but where Lhotsky had politics Menge kept religion, apparently a more socially-acceptable eccentricity. Few in South Australia seem to have thought Menge a nuisance. Also unlike Lhotsky, he came to minerals the practical way. At the age of 17 Menge began assisting

K. C. von Leonhard in the latter's mineral dealing business at Hanau. That he made some impact is clear from a record left by J. W. von Goethe [1749-1832] of a visit in July 1814 when Goethe was shown the stock by Leonhard's '*Faktor Joh. Menge*' (Goethe, 1949: 59). After Leonhard became professor of mineralogy at Heidelberg in 1817, Menge ran the business for a time. He then adopted the life of a travelling collector, first in Iceland (1819) and, later, in the Ural Mountains. His grasp of mineralogy can be judged from the published accounts of his travels (see Vallance, 1975: 41) and an uncommon monograph issued at Hanau (Menge, 1819). In eponymous honour Menge ranks among the unfortunates, indeed the doubly unfortunate. Through confusion among J. F. A. Breithaupt [1791-1873], H. J. Brooke [1771-1857], A. T. von Kupffer [1799-1865] and Gustav Rose [1798-1873], all of them students of Menge specimens from the Urals, 'mengite' twice emerged as a mineral name and twice dropped into synonymy, in one case supplanted by ilmenite (also of Menge's collecting) which has displaced our earlier menachanite.

This pioneer of Uralian mineralogy moved to London in 1830, as dealer in minerals and teacher of languages. In 1836 he became mine and quarry agent to the South Australian Company, then planning its colonizing experiment. Menge reached Australia in January 1837 but after little more than a year with the company his employment was terminated. He remained in South Australia to follow the style he plainly preferred, that of a solitary prospector. By 1840 his list of minerals found in the colony had appeared in an Adelaide newspaper. There and in later lists, published and unpublished (South Australian Archives), one finds idiosyncratic names like 'gawlerite' ('a red mineral') and 'sturtite' alongside others familiar and recognizable. Whatever Menge's 'sturtite' may have been, one can be confident it was not the same as the material from Broken Hill given that name in 1930. In South Australia Menge seems not to have maintained links with those who once welcomed his specimens. For minerals not identified by the simple field tests to which he now had access Menge simply devised his own names. It was no exemplary principle but, fortunately for mineral taxonomists, even those Menge names that got to print were not in recognized media. One suspects Menge did not care; his message was to fellow colonists, not to scientists abroad. He wanted local people to know about minerals and the mineral riches (including precious opal which he had found) beneath them. Menge, at least, was not surprised in 1841 when lead ore was found near Adelaide. With that and other finds soon after the then youngest of the Australian colonies became the first to develop a metalliferous mining industry, lead and copper mainly, but also gold. No one denied the inspirer of colonial metal mining his Australian soubriquet 'Menge the Mineralogist' (Cawthorne, 1859).

By the mid-1840s South Australia was attracting people with practical knowledge of minerals, miners, assayers and the like. The first monograph on geology and mineralogy to appear in Australia (Burr, 1846), a work by the then deputy surveyor-general of South Australia Thomas Burr [1813?-1866], even had a local market; other copies went overseas to publicize the colony's mineral riches. A contemporary work (Dutton, 1846) by F. S. Dutton [1818-1877] had a like purpose. It has the added interest of reference to the chemical and mineralogical skills of a fellow-colonist C. D. E. Fortnum [1820-1899] and chemical data on South Australian atacamite supplied by the Dr Ure who had sold his apparatus to Sydney College. Information, including data from colonial analysts, among whom Edward Davy [1806-1885] was already prominent in Adelaide, began to attract attention in Europe (e.g. Tremenheere, 1846). So also did collections of South Australian ore minerals. These were no longer accidental pickings along the path of an explorer but suites that could invite study of associations. James Apjohn [1796-1886] in Dublin (Apjohn, 1851) and A. L. Sack [fl. 1849-1852+] at Halle (Sack, 1851) were among the first to respond.

Overseas awareness of Australian minerals was being re-kindled, and far more productively than in the days of Sydneia. A sign of how that new interest grew can be traced through the American *A System of Mineralogy* by J. D. Dana [1813-1895]. The second edition (1844) mentions only coal and wood opal from Australia. To these in the third edition (1850) are added alunogen, galena, chalcopyrite, cuprite and apophyllite; by the fourth (1853) gold, diamond, corundum and atacamite from Australia also have their places. Even these, of course, were not exhaustive. Dana, writing at Yale, introduced only what he considered of general interest, whether in terms of occurrence or more often by dint of some supplementary information. He was, however, better placed than most of his foreign colleagues; he had visited Sydney in 1839-40 and travelled a bit in New South Wales. His concerns then were more broadly geological though his account of observations in the colony published in 1849 includes illustrated notes on the calcite pseudomorphs at Glendon (see Dana, 1884: 29, 34) now known as glendonites. The identity of the pseudomorphed phase for these and similar bodies in other parts of the world has long been a puzzle. Shearman and Smith (1985) suggest they derive from the calcium carbonate hexahydrate ikaite. Curiously, Dana seems to have found no place even in the fourth edition of *A System* . . . for these pseudomorphs from New South Wales, though comparable examples were mentioned under gaylussite and 'natrocalcite'. But then he also overlooked the remarkable malachite and azurite being yielded by South Australia. To discover that these were already known overseas, one has only to inspect the frontispiece to Varley (1849) and the catalogues and reports of the great exhibition of 1851 in London.

The success of that London exhibition set a style emulated through the rest of the century. Exhibitions became show-places for Australia's minerals; their catalogues afford means for tracing progress in mining activity and, less directly, in mineralogy. Change came swiftly. Even before the 1851 exhibition had closed its doors for the last time, word was abroad of gold discoveries in New South Wales and of people flocking there in pursuit. Copper mines had been operating in the original colony for a few years, like lead-mining in Western Australia as offshoots of South Australian enterprise. Such activities, however, had no defence against the lure of gold and when, later in 1851, the Port Phillip district, newly detached from New South Wales as the colony of Victoria, was also found to be auriferous, southeastern Australia began to repeat the Californian experience of 1849. This was indeed a turning point. The resident interest in Australian minerals that had grown slowly over half a century, and more particularly in the decade since metal mining began, became surpassing. From the change arose circumstances that would allow development of more or less independent studies of scientific mineralogy in Australia.

The Golden Legacy: Australian Mineral Science

From 1851, gold transformed Australian society and nowhere more plainly than in Melbourne, a quiet provincial town that soon had to serve as capital of the country's richest colony, Victoria. At Sydney a university was in due process of creation before the gold rushes erupted; teaching began in 1852. No provision had been made for a teacher of mineralogy but, as a manifestation of local concern, one notes the gift of Edward Deas-Thomson [1800-1879] in 1854 of funds to establish within the university three scholarships to encourage natural science. The third of those scholarships was for mineralogy. By 1855 Melbourne also had a university, a new natural history museum and, significantly ahead of Sydney, the beginnings of a well-organized geological survey and two scientific societies about to publish journals. If all these depended on minerals, not one of them at the time employed a mineralogist. The founding scientific professors in the universities, in Sydney a chemist John Smith [1821-1885], in Melbourne a palaeontologist Frederick McCoy [1817-1899], only nodded to minerals in their classes, though Smith had sufficient curiosity to tour the goldfields in 1860. McCoy, by establishing control over the Melbourne museum and close links with the government mining department and geological survey, gained the means to acquire minerals and advance their study; he seems to have been content with acquisition. Neither universities nor natural history museums would provide the first institutional milieu in Australia for mineralogical research. How strikingly that matched the example of the colonies' motherland.

In 1850 both Oxford and Cambridge claimed to have professors of mineralogy. Cambridge indeed had in its chair the celebrated crystallographer W. H. Miller [1801-1880] but where were the mineralogists he trained? Oxford did not even have a mineralogist as professor of mineralogy until M. H. N. Story-Maskelyne [1823-1911] succeeded the geologist William Buckland [1784-1856] in 1856. Furthermore, the influence of men like Buckland had helped fix British earth science interests on palaeontology and stratigraphy. The British Museum's extensive collection of minerals enjoyed no specialist keeper until 1857 when Story-Maskelyne added that duty to his office at Oxford. Notwithstanding some notable individual achievements, British mineralogy was backward by continental standards at the middle of the nineteenth century. Great Britain had done practically nothing to match the system of scientific and technical training begun in Europe over the past hundred years. British shortcomings in this regard seem only to have been admitted and repaired with the 1851 exhibition. One consequence was the establishment in London of a Royal College of Science, embracing among others a school of mines, for which European precedent went back at least to 1765 and the Freiberg *Bergakademie*. Graduates of the London college in time would contribute to Australian science and industry but the early lead, almost of necessity, came from Europe. There was no contemporary British work on Australian minerals to approach in quality researches published in the period 1855-75 by, for instance, A. L. O. L. Des Cloizeaux [1817-1897] on quartz, J. F. C. Klein [1842-1907] on atacamite, Albrecht Schrauf [1837-1897] on azurite and brochantite, and V. L. von Zepharovich [1830-1890] also on atacamite. Even Australian samples in the British Museum, of malachite, chabazite and others, came to notice through the attention of Viktor von Lang [1838-1921].

Scientific interest in the copper minerals of South Australia plainly continued. Indeed alluvial gold-diggings could hardly compete with rock mining as the source of fine crystal specimens. Few gold nuggets were left for study or display though analyses such as those of G. H. B. Kerl [1824-1905] in Germany and A. B. Northcote [1831-1869] in London early revealed the contrasted compositions of Australian and Californian gold (Kerl, 1853; Northcote, 1853). Gem stones from auriferous drifts received attention from G. M. Stephen [1812-1894] and, later, J. I. Bleasdale [1822-1884] (Stephen, 1854; Bleasdale, 1866); according to Bleasdale, Stephen coined the name *barklyite* for a nearly-opaque, magenta-coloured variety of corundum found in the Victorian drifts. The label was meant to honour Sir Henry Barkly [1815-1894], governor of Victoria 1856-63, but where Stephen first announced it has not been traced. It receives comment here because, unlike Menge's terms honouring local notables, this one did get into mineralogical literature. Of other minerals turned up in alluvial workings, one notes cassiterite from the Ovens River, samples of which were seen in Sydney by F. H. Storer [1832-1915], chemist and geologist to the U.S. North Pacific Exploring Expedition. In a letter dated U.S.S. *Vincennes*, Port Jackson, 4 January 1854 and printed in the *Sydney Morning Herald*, Storer gave some account of his examination. There were also early reports of natural gold crystals from drifts, for instance by Stephens (1854), but similar material was regarded by Lang (1863) as artificial. Natural gold crystals became well-known and prized after the advent of reef-mining. The status of zinc reported to occur in basalt near Melbourne by the German-born artist and naturalist L. P. H. Becker [1808-1861], and regarded by him (Becker, 1857) as native, raises kindred problems.* Here was the first claim that elementary zinc occurred in nature. A few others, some from Australia, have followed. Opinion as to whether these are instances of genuine native element has varied over the years; one suspects a more favourable view is beginning to return. Unfortunately, Becker's material has long since disappeared but no one can deny the interest of this, his mineralogical legacy.

Becker (1857) made a significant acknowledgement, to 'Mr George Ulrich (a gentleman employed by the Mining Commission, and whose ability, as also care and exactness in analysing inorganic bodies is well known)'. Perhaps Ulrich had a hand also with the mineralogical remarks in the zoologist Blandowski's accounts of excursions in Victoria that were published in the same volume as Becker's paper. J. W. T. L. Blandowski [1822-1878?], naturalist at the Melbourne museum, clearly held some concern for minerals and might have done more useful work in that regard. His falling-out with McCoy in 1856, however, over arrangements for the museum put an end to such hope. But from what might have been we return to what was. In 1857 G. H. F. Ulrich [1830-1900], the man thanked by Becker, joined the geological survey in Victoria. The new recruit had qualified at the *Bergakademie* in Clausthal as a mining geologist. To the mastery of mineral science gained there Ulrich, since his arrival at Melbourne in 1853, had added experience as a digger on the goldfields and then as an assistant to the mining commission. Although assigned to the survey's field-mapping programme Ulrich quickly demonstrated his particular interest in a paper describing the uncommon minerals pharmacosiderite and scorodite from auriferous quartz reefs at Tarrengower, Victoria (Ulrich, 1857). When, in 1862, the survey added a chemist to its staff, Ulrich took the opportunity to promote the study of samples collected by field parties. C. S. Wood [1837-1864], the first chemist, however had little chance to make an impact; he was already ailing when appointed. Ulrich had to await the arrival of his successor, J. C. Newbery [1843-1895], a graduate of Harvard University but, like Wood, also trained in the new London college. With the chemists as collaborators, Ulrich could look back and forgive the pushy R. B. Smyth [1830-1889] for publishing on a supposed new mineral (Smyth, 1858) and using Ulrich's inconclusive remarks without permission. Ulrich, in fact, soon after showed the new mineral was only bournonite.

In a work (Selwyn and Ulrich, 1866), prepared with his survey chief as an exhibition essay, Ulrich offered a descriptive list of Victorian minerals, mostly of his determining. Three years later came an announcement that, for mineral science in Australia, retains great significance. It was the first record from Australia of a mineral species new to science and still recognized as valid. The novelty of the material Ulrich called *maldonite* after its source locality had been established in Melbourne and its formula Au_2Bi fixed from Newbery's analyses. However, what ought to have been a year for rejoicing turned out otherwise. Economic uncertainty had succeeded golden prosperity in Victoria. To save money the government disbanded its geological survey. Fortunately for mineralogy, and Ulrich and Newbery, new opportunity appeared in Melbourne. At the end of 1869 the government agreed to reorganize its public museums (Pescott, 1954). The mineral, mining and agricultural collections of what had become McCoy's museum were transferred to a new Industrial and Technological Museum. There, at last, minerals would be in sure hands; in 1870 Newbery became scientific superintendent and Ulrich in effect his curator of minerals in the new institution. The fruitful

* So does the tin found in stream-washings near Oban, New South Wales, and reported as native element by F. A. Genth [1820-1893] of Philadelphia (Genth, 1886: 30-31).

collaboration of these two continued at the museum until 1878 when Ulrich left to become professor of mining at Dunedin, New Zealand.

Ulrich's curatorship practically began with a notable work (Ulrich, 1870) that supplied further detail on maldonite as well as many new data on ore minerals, on zeolites, on struvite found in Skipton Cave near Ballarat, and two materials Ulrich named 'selwynite' and 'talcosite', thinking them new species. The latter need not detain us, they were long ago shown to be fine-grained mixtures, but the study of struvite deserves remark. Besides analyses made by Newbery's assistant E. F. Pittman [1849-1932], Ulrich presented a list of angle measurements on crystals and other descriptive detail. If those measurements were made by Ulrich, and he acknowledges no source, they stand as the earliest results of crystal goniometry obtained and published in Australia.

At the museum Ulrich and Newbery continued their study of the Skipton guano, a sort of material many mineralogists might consider uninviting. Yet thanks to the skill and enterprise of this pair Skipton Cave was to become the most prolific single source of new mineral species in colonial Australia. Reference works attribute authorship of *hannayite* and *newberyite* (Table 1), both from Skipton, to Ulrich's friend J. J. G. vom Rath [1830-1888] of Bonn. While there is no question Rath published the names, and contributed crystal data, it must be pointed out the material went to him from Melbourne with chemical and other detail that indicated the novelty was already recognized. Ulrich and Newbery deserve to be known as co-authors; so does a young chemist R. W. E. MacIvor [1856?-1917]* who made many of the analyses and suggested the name *hannayite*. Hannay (1878), incidentally, offers another Australian link but the mineral from Victoria (and not supplied by MacIvor!) there described as 'youngite', a sulphide of zinc and lead, is now taken to be a variety of sphalerite and not a distinct mineral species. Returning to *hannayite*, it should be noted that even Rath (1879) admitted MacIvor's essential part in the discovery. Ulrich and Newbery had befriended MacIvor on his arrival in Melbourne and, with the newcomer's interest in fertilizers, it was natural he should be drawn into the study of the Skipton guano. MacIvor, in fact, would take over the work after Ulrich's departure for New Zealand.

Two more new phosphate species from Skipton were announced by MacIvor (1887) on his return to London. However, only one of the names he then proposed, *dittmarite*, is still considered valid. The problem with the other arose from no failure in MacIvor's science but incompleteness in the published statement. In 1887 he had suggested

* It is cause for regret we know so little about this active contributor to Australian mineralogy. No obituary has been found, but the death certificate for Ralph Waldo Emerson MacIvor (General Register Office, London) shows he died, aged 61, at his residence in Harrow, Middlesex, on 1 April 1917. Fruitless search of birth records for 1855-7 in London and Edinburgh suggests he was born outside England, Wales or Scotland. Robertson (1982: 258), however, points to early residence in Scotland and association with John Ballantyne Hannay [1855-1931] in chemical experiments at the latter's parental home at Helensburgh. That youthful association is recalled in the mineral name *hannayite*. MacIvor attended the Andersonian University, Glasgow, and was for a time assistant professor of chemistry there. Wilhelm Dittmar [1833-1892] and Arnulf Schertel [1841-1902], both remembered in Australian minerals named by MacIvor, were his teachers and/or colleagues in Glasgow.

MacIvor moved to Victoria, probably late in 1875, at the invitation of a wealthy landowner, Sir William Clarke [1831-1897], to set up a laboratory and provide farmers with lectures and advice on agricultural chemistry. While in Melbourne he edited *MacIvor's Farmers' Year Book* and wrote *The Chemistry of Agriculture* (Melbourne, 1879) and *Agricultural Chemistry* (Brisbane, 1879). His portrait will be found in J. Periam's *The Pictorial Home and Farm Manual* (Sydney, 1885), which MacIvor adapted for Australasian readers. He was an unsuccessful applicant for the chair of chemistry at the University of Melbourne in 1882 (Radford, 1978: 29), and a member of the Royal Society of Victoria 1880-3. About 1887 MacIvor came to Sydney as head of the agricultural department in the technical college but seems to have stayed barely a year. He returned to London where he was active for some two decades as a consulting chemist. In his early years at least MacIvor was member or fellow of various chemical societies (Radford, 1978: 23). He was F.R.G.S. 1887-*c.*97 but at no stage seems to have been a notably active supporter of scientific societies.

TABLE 1

Valid new mineral species yielded by Australia in colonial time (1788-1900)

Name	Formula	Colony	Author(s)	Year
MALDONITE	Au_2Bi	Victoria	Ulrich	1869
HANNAYITE	$(NH_4)_2Mg_3H_4(PO_4)_4.8H_2O$	Victoria	Rath (Ulrich/MacIvor)	1878/9
NEWBERYITE	$MgHPO_4.3H_2O$	Victoria	Rath (Ulrich/MacIvor)	1879
DITTMARITE	$(NH_4)MgPO_4.H_2O$	Victoria	MacIvor	1887
SCHERTELITE	$(NH_4)_2MgH_2(PO_4)_2.4H_2O$	Victoria	(MacIvor)	1906
syn: schertalite (MacIvor, 1902), muellerite (MacIvor, 1887)				
MARSHITE	CuI	New South Wales	Liversidge	1892
DUNDASITE	$PbAl_2(CO_3)_2(OH)_4.H_2O$	Tasmania	Petterd	1892
STIBIOTANTALITE	$SbTaO_4$	Western Australia	Goyder	1893
WILLYAMITE	(Co,Ni)SbS	New South Wales	Pittman	1893
HEAZLEWOODITE	Ni_3S_2	Tasmania	Petterd	1896
RASPITE	$PbWO_4$	New South Wales	Hlawatsch	1897
MIERSITE	(Ag,Cu)I	New South Wales	Spencer	1898
SULVANITE	Cu_3VS_4	South Australia	Goyder	1900

'muellerite' (to honour the botanist F. J. H. von Mueller [1825-1896]) as name for a phase identified only by chemical formula. Some years later, an Italian mineralogist applied a similar name to another mineral described in some detail. Ironically, Zambonini's 'müllerite' (1899) is now discredited but at the time, though junior to MacIvor's term, it was preferred. So MacIvor (1902) amended his 'muellerite' to 'schertalite', which in 1906 had to be corrected to *schertelite.* MacIvor had misspelled the name of his Glasgow friend, who had since followed a distinguished career as professor in the *Bergakademie* at Freiberg. *Dittmarite* and *schertelite* are names credited to MacIvor and although the second belongs to this century both represent discoveries from colonial Australia. No one in the Australian colonies had more success recognizing valid new mineral species than MacIvor, and no one is more undeservedly overlooked.

The year 1888 marked the centenary of British settlement of Australia; the separate colonies that became states of a commonwealth at federation in 1901 were already firmly established. In that century Australia had yielded five mineral species new to science and still deemed valid. Every one of them was from Victoria and had been recognized as novel in Melbourne. And in some way Ulrich was connected with each. That, I believe, is the measure of G. H. F. Ulrich's achievement as Australian mineralogist and inspirer of mineralogists. With the mastery he brought from Germany, he was surely the founder of scientific mineralogy in Australia; and he made Melbourne the founding centre. Of course, he could at times be misled, as 'selwynite' and 'talcosite' showed, but such fine-grained materials not evidently-crystallized would continue to raise problems until the advent of X-ray diffraction methods. Edward Goldsmith [1833?-1925] of Philadelphia had been similarly misled into thinking an alteration product on stibnite, part of a collection of Victorian minerals exhibited in Philadelphia in 1876, was a new mineral. The 'stibianite' of Goldsmith (1878) was long ago discredited.

As Ulrich's inspiration in Melbourne faded, so the pace and quality of mineralogical research there subsided. His successor at the museum until 1892, the Australian-born O. R. Rule [1835-1926], though an energetic collector, made no particular impact on science (Coulsell, 1980). A young man fresh from Ulrich's classes at Dunedin followed Rule but he, R. H. Walcott [1870-1936], soon found himself enmeshed in museum politics that led to his mineral collection returning to the older natural history museum. Walcott had few opportunities to show scientific mettle in his early Melbourne years. Yet Ulrich's going had not quite extinguished Victoria's mineralogical light. A candle burned, a miner's candle. During the 1870s mining schools had sprung up on the goldfields, in Ballarat (1870) and Bendigo (1873) at the start. These became the places where much of the basic mineralogy taught in the colony was offered. From men like the chemist A. M. Smith [1844-1926] and the geologist F. M. Krause [1841-1918] Victorian students learned there was more to minerals than was extractable in a treatment works. Krause (1896) aimed to serve the needs of such students.

Meanwhile, leadership in Australian mineralogical research had passed to Sydney. There had been signs, even while Ulrich lived in Melbourne, of activity in the older city that could make it a rival. With Ulrich's departure any rivalry became one-sided in favour of Sydney. The shift involved a distinct contrast of styles. Ulrich had made the Technological Museum in Melbourne a centre for excellence in mineralogy; in Sydney the science became fixed in the university. Ulrich's collaboration with Newbery and other chemists brought an enviable breadth to mineralogical research in Melbourne. The results that began coming from Sydney about 1870 were from the start more focused, more particularly chemical. Sydney's mineral science reflected the educational origins of its leading exponents, Britons trained as chemists in the United Kingdom. They, it seemed, possessed little of the enthusiasm for crystallography and physical mineralogy enjoyed by mineralogists like Ulrich of German training. The distinction of mineralogy in colonial Sydney arose from the quality of its chemists.

In 1866 A. M. Thomson [1841-1871] joined the University of Sydney to assist in the teaching of practical chemistry and, as reader, to offer instruction in geology and mineralogy. Of these latter he was soon promoted professor, the first in Australia. At the end of a sadly-short career his legacy included several papers, a book on minerals (Thomson, 1869) of an elementary and practical character, the beginnings of a rock and mineral collection at the university, and many unpublished analyses that passed to his successor Archibald Liversidge [1847-1927], like Thomson a product of the London college (Branagan, 1973: 3-6). Two years after coming to Sydney, Liversidge in 1874 became professor of geology and mineralogy; from 1882 until his retirement in 1907 he was professor of chemistry, and of mineralogy also for much of that time. If by 1888 Victoria had five new mineral species to its credit, New South Wales had a work of information about minerals unmatched in colonial Australia. Liversidge (1888) was the third edition of a collection begun before 1874 and first published in 1876. In the history by P. H. Groth [1843-1927], *'das wertvolle Werk'* of Liversidge is rated the outstanding source for Australian mineralogy (Groth, 1926: 159). Certainly, by 1888 it had become an impressive tome, a remarkable token of what, in the main, Liversidge himself had done. But already Liversidge's achievement went beyond that of an assiduous individual investigator. His position and influence enabled him to promote his favoured science elsewhere in Sydney.

By 1888 Liversidge could recall the establishment of the geological survey of New South Wales and of a government mining museum that lost its collection by fire in 1882 and had started anew. Later, with appointment of the London-trained G. W. Card [1865-1943] in 1892 the museum, in collaboration with geological survey chemists, would gain respect as a place for mineralogical research. For Liversidge, however, his closest ties outside the university remained with the Australian Museum which, like Thomson before him, he served as a trustee. Both men gave unstinting honorary attention to the museum's minerals. Thomson indeed is acknowledged as identifier of the Australian material listed in the museum's first mineral catalogue (Krefft, 1873), compiled by the zoologist J. L. G. Krefft [1830-1881], secretary and curator of the whole museum. Liversidge continued what Thomson began and his hand was surely behind the eventual decision to employ a curator of minerals in 1881 (see p. 161). That Ratte (1885) could list a collection apparently more than doubled in size in twelve years reflected well on an active curator and a no less active trustee. Ratte however seems to have found little time for original research on minerals. He may, in fact, have possessed neither the means nor experience to go much further than straightforward determinative mineralogy, but any doubts on that score became unhappily irrelevant when Ratte suicided after nine years in office. His successor, Thomas Cooksey [1864-1945], a chemist trained in England and Germany, held the post until 1899 when he turned to other fields. Cooksey had published a few mineralogical notes, none of particular importance, and it was not until after Charles Anderson [1876-1944] from Edinburgh joined the museum in 1901 that research there in mineral science became impressive. Anderson's expertise in crystallography and physical as well as chemical mineralogy was something hitherto rare among British graduates settling in Australia. Anderson brought to Australia shining evidence of how, at last, mineralogical training in Great Britain had learned to profit from continental European experience. Although his Australian career was entirely post-colonial, students of that earlier period find his bibliography (Anderson, 1916) a valued key.

If Liversidge (1888) could point to no new mineral species from New South Wales, there were already some remarkable finds from Broken Hill to report. Discovery of silver-lead-zinc deposits there in 1883 had opened a new phase in colonial mining activity and a major source of fine mineral specimens (Worner and Mitchell, 1983). From Broken Hill were to come all the new species contributed to mineralogy by colonial New South Wales. Miners, managers and townspeople (among them, notably, the publican E. H. Aldridge [d. 1909]) at Broken Hill succumbed to the brilliance of crystallized ore and gangue minerals. As Australia's best-known mineralogist and the only one a fellow of the Royal Society of London, Liversidge became the referee for those local mineral collectors and amateur mineralogists. The natural copper iodide Liversidge termed *marshite* in 1892 appeared in analysed samples sent to him by C. W. Marsh [fl. 1890-1909+] of the British Mine. In view of Marsh's eponymous fame it is to be hoped more can be discovered about his career; I lose track of him on the mineral fields of Western Australia. The variety and quality of Broken Hill specimens quickly attracted the notice of overseas mineralogists. Among such material at the British Museum L. J. Spencer [1870-1959] in 1898 recognized the silver analogue of marshite which he named *miersite* after the British mineralogist H. A. Miers [1858-1942]. A year earlier Carl Hlawatsch [1870-1947] in Vienna found the new mineral *raspite*, named for the discoverer of the Broken Hill deposits Charles Rasp [1846-1907], in collections made by Heinrich von Foullon [1850-1896] during his ill-fated tour. But even locally not everything went to Liversidge. The cobalt nickel antimony sulphide called *willyamite* (a name still current, though redefined (Cabri *et al.*, 1970), it derives from the intended title for the town of Broken Hill) in 1893 by E. F. Pittman, once Newbery's assistant in Melbourne and at the time government geologist of New South Wales, had been sent to the geological survey by the mine manager and amateur of minerals George Smith [1861-1944].

The literature of Australian mineralogy in late colonial times has many contributions from informed amateurs like George Smith. D. A. Porter [1851-1928], an inspector of school buildings in the New England region of New South Wales, for instance emerged as a leading authority on the minerals of that region. Porter's papers, and those of others mentioned here, are listed in Anderson (1916). However, preeminent among amateurs was the Tasmanian dealer in boots and shoes W. F. Petterd [1849-1910]. 'Petterdite', erected by his geological friend W. H. Twelvetrees [1848-1919], has alas been discredited but Petterd himself is remembered as author of *dundasite* (1892) and *heazlewoodite* (1896), both for type localities in his native Tasmania, and of the first extensive census of Tasmanian minerals (Petterd, 1893).

Petterd's census was but one of a number that expressed the remarkable growth of knowledge about Australian minerals during the last few decades of the nineteenth century. Again, Liversidge inspired the effort. At its inaugural meeting in Sydney in 1888 the Australasian Association for the Advancement of Science, a body effectively founded by Liversidge, set up a continuing committee for mineral census with Liversidge its secretary. Two years later progress was reported in Melbourne, the committee papers being printed with the record of that second congress. For the occasion Liversidge supplied additions relating to New South Wales since his book of 1888. E. B. Lindon [1860-1891], briefly mineralogist to the Queensland Museum and since 1887 in practice as a mining engineer, likewise revised an earlier list (Lindon, 1887). The colony of Queensland, not previously mentioned here, already had a flourishing mining industry but few facilities for higher education and scientific research. Such mineral investigations as were conducted in Queensland took place mainly in the natural history museum (Queensland Museum) in Brisbane or in the geological survey and government chemical laboratory. Serviceable links existed between them; indeed the government chemist K. T. Staiger [1833-1888] in the 1870s was also honorary custodian of the museum and curator of its minerals. Between him and Lindon the minerals were in the care of one H. F. Wallmann (Vallance, 1983b: 272), a shadowy figure remembered, if at all, for a paper on mineral pseudomorphs. Colonial Queensland in one regard, however, gave a lead to Australia. It alone, as far as I am aware, employed what became known as travelling mineralogical lecturers. One such lecturer, A. W. Clarke [1857?-1893], was a member of Liversidge's committee; later, briefly, he served as government chemist in Queensland.

Ulrich's successor, Rule, was one of two Victorians on the mineral census committee but the colony once preeminent in Australian mineralogy furnished nothing in 1890. The deficiency was not repaired until the appearance of Atkinson (1897), to which Walcott (1901) added more detail. Who this worthy compiler John A. Atkinson was remains for me a mystery. His claim 'that Victoria seems to rank highest of the colonies in the number of its mineral species' (Atkinson, 1897: 69) suggests local pride. Yet the work deserves respect for what seems critical treatment. One notes, for instance, no mention by Atkinson (or Walcott for that matter) of the mineral from Yarraville analysed and described by Thomas Steel [1858-1925] as near dawsonite in composition (Steel, 1890), a record even taken up by Anderson (1916). Steel's data make little sense; I am impressed that Atkinson ignored them.

Strangely, Liversidge's committee had no representative from South Australia, where metal-mining in this country began. There had long been a museum (Hale, 1956) in Adelaide, and a university there since 1875. Neither had a mineralogist though the professor of chemistry, E. H. Rennie [1852-1927], born in Sydney and a student of A. M. Thomson, once took an interest in the so-called rubies (garnets) of South Australia. In 1899 his sometime lecturer, A. J. Higgin [1860?-1922], brought to science an account of the rare nickel telluride mineral melonite from Worturpa. In general, however, the Adelaide university chemists did not follow Liversidge into mineralogy. H. Y. L. Brown [1844-1928], government geologist in the colony from 1882, through his many reports helped spread information about the distribution of minerals but mineralogy itself depended more on amateurs like the metallurgist T. C. Cloud [1847-1918] of the Wallaroo mines. Cloud, who gave spare-time honorary service to the museum, had prepared a local mineral census (Cloud, 1883). He revised it for Liversidge to present in the name of South Australia in 1890. By then Cloud was not alone. Schools of mines in Adelaide and regional centres had begun to spread interest in minerals. J. J. East [fl. 1884-1911+], another of our little-known pioneers, deserves mention. It was East, while attached to the Adelaide school of mines, who arranged the examination of material from Greenbushes, Western Australia, in which G. W. Goyder [1855-1940] found the new mineral *stibiotantalite* (1893). For a time government chemist in his native South Australia, Goyder was also responsible for recognizing the only new mineral species yielded by that colony, *sulvanite* (1900) from the Burra district.

There was no one from Western Australia on the census committee and in 1890 no report. After the mining episode of the 1840s that colony, vast in area, had all but abandoned such activity until the discovery of gold there in the 1880s. Yet the colonists' interest in minerals had not quite vanished over the intervening years. Mainly through the efforts of men like the clergyman C. G. Nicolay [1815-1897] minerals gained places in Western Australian displays at the international and intercolonial exhibitions that became such a feature in the wake of London and 1851. Nicolay himself kept a geological museum at Fremantle and this in 1889 became part of a public natural history museum in the capital, Perth. Two years later B. H. Woodward [1846-1916], of a family well-known in British geological circles, was appointed custodian and assayer at the new museum. He seems to have left few signs of activity as a mineralogist. In that regard his cousin H. P. Woodward [1858-1917], sometime government geologist of Western Australia, did better. H. P. Woodward's geological and mining reports contain many notes on mineral occurrences. One might add that they are reasonably typical of the sort of mineral work done by colonial geological surveys in Australia at this time — estimable, but mineralogically unexciting. In 1896, however, A. G. Holroyd [1865?-1931] announced the discovery of telluride ore in the gold mines at Kalgoorlie. If Broken Hill hitherto had been an Australian focus for mineralogists across the world, it now was forced to share interest with Kalgoorlie and Coolgardie. In the ensuing excitement two supposed new telluride species emerged, the 'kalgoorlite' (1898) of Pittman and 'coolgardite' (1901) of M. A. Carnot [1839-1920] in Paris. Both were discredited as mixtures by L. J. Spencer in 1903. But that is already beyond our period.

The significant achievements in Western Australian mineralogy really belong to the present century. Yet even before the Australian colonies came together as states of a commonwealth in 1901 one of the principal makers of that western achievement had started his life's work. In 1897, E. S. Simpson [1875-1939], a Sydney graduate trained under Liversidge, joined the mines department in Perth as its mineralogist and chief chemist. Three volumes of the posthumously-published *Minerals of Western Australia* bear witness to Simpson's devoted service. One wonders if his teacher's book of 1888 inspired emulation. At any rate it is a notable fact that, so far, only New South Wales and Western Australia have been thus served. In that regard the mineralogical legacy from Australia's colonial period has yet to be fully developed. But the seemingly-diminished tendency to compile grand regional mineralogies during the present century has been offset by successful re-establishment of broadly-based mineral research.

At the outset of Australian colonization, interest in minerals had been delayed by British partiality, the sort of partiality that allowed mineral nature chiefly a utilitarian value. Such value, not considered relevant by the original planners, however gained recognition as Australian exploration and settlement advanced through the nineteenth century. And with exploitative interest came also that of science. Nevertheless, at the end of the colonial period Australian mineral studies were still dominated by British partiality, this time that of chemists trained in the United Kingdom before about 1880. The breadth of contemporary German mineralogy Ulrich had brought to Melbourne effectively left with him. His chemist friends Newbery and MacIvor shared background with Liversidge, whose claim to leadership of the science in Australia was already clear. Under the chemists, distinguished as they were, physical aspects of mineralogy received scant attention. Crystallography, in particular, was left largely to outsiders, in Europe, in the United States of America and in Great Britain where, increasingly towards the end of the century, mineralogists began making study-pilgrimages to Europe.

The contrast of styles here and abroad is evident in the treatment of new species from Broken Hill during the 1890s. The definition of *marshite*, for instance, emerged from the data of analytical chemistry provided by Marsh and Liversidge. On the other hand, Hlawatsch's treatment of *raspite* embraced not only chemical data but a wealth of morphological information. Even Spencer's record of *miersite*, though brief, noted the crystal character of that mineral, and of *marshite*. The Englishman Spencer, by the way, after leaving Cambridge had studied with Paul Groth in Munich as preparation for duty at the British Museum (Smith, 1959: 182).

Nor was the contrast confined to new species. The crystallographic investigation of Tasmanian crocoite by Charles Palache [1869-1954] of Harvard University (Palache, 1896) added a new dimension to knowledge of that colony's minerals. Other overseas studies took up what had been pioneered long before. Thus the morphological observations of Australian topaz (Eakle, 1898) by the Stanford mineralogist A. S. Eakle [1862-1931] stand in succession to what Haüy's student Armand Levy [1791-1841] in a way began with his records of Australian samples in a British collection (Levy, 1838: I, 267-268, 274-275, 286).

It is not my intention, however, to parade such deficiencies which, in any case, began to be put in process of repair with the arrival in 1901 of Charles Anderson at the Australian Museum. From its uncertain beginnings in a country scarcely known, the scientific study of minerals here had become firmly established before the separate Crown colonies became one nation. Mineralogy in colonial Australia may not have changed the course of the science but the country had already contributed an impressive tally of substances never before recognized in nature, substances that are still admitted as valid mineral species.

ACKNOWLEDGEMENTS

Barry Cooper and David Corbett (Adelaide), Tom Darragh (Melbourne), Peter Embrey (London), David Johnston (Cambridge), Peter Schmidt (Freiberg), Carol M. Spawn (Philadelphia) and Hugh Torrens (Keele) are thanked for generous help. Access to the collections of the British Library and the British Museum (Natural History) in London, the Mitchell Library (Sydney) and the Alexander Turnbull Library (Wellington, N.Z.) has been a privilege deeply appreciated.

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APPENDIX

Botanists, Mineralogists, and Zoologists appointed to the French Expedition to Australia 1800-04

BOTANISTS

1. André MICHAUX [1746-1802] — *Dict. Amer. Biogr.* 12: 591-592

A man with far wider experience than any of his colleagues on the expedition, Michaux had already travelled as a botanist in France, in Iran and Iraq, and in North America, and held the rank of associate in the *Institut National* (Cornell, 1965: 57). The document quoted by Cornell indicates Michaux's place as 'first botanist', a statement hard to reconcile with Bory de St Vincent's (1805: 6) claim that Michaux travelled on the *Naturaliste* as a passenger free to make his own plans. At any rate, on arrival at Mauritius (March 1801) Michaux informed the commander, Baudin, he would accompany him no further. He left the expedition to botanize privately on Mauritius and in Madagascar, where he died.

2. André Pierre LEDRU [1761-1825] — Michaud *Biogr. Univers.* 23: 565-566

Formerly a clergyman, Ledru obtained a teaching post in the *École Centrale*, Le Mans, after returning from the voyage (1796-8) to the West Indies led by Baudin, and of which he became chronicler (Ledru, 1810). Appointed second botanist to the Australian expedition, Ledru had to withdraw for private reasons a few months before it departed 19 October 1800. The vacancy created was not filled by a botanist but by an extra junior zoologist, an arrangement that matched Georges Cuvier's interest but extraordinary if Michaux were known to be only a passenger.

élève 1. Jean Baptiste Louis Claude Théodore LESCHENAULT DE LA TOUR [1773-1826] — Michaud *Biogr. Univers.* 24: 294 (but errors)

An *élève* at the *Muséum* in Paris when appointed, Leschenault de la Tour was to serve as the expedition's only botanist after his colleagues found reasons to stay at Mauritius on the outward voyage. He had to be left sick at Timor in June 1803 during the *Géographe*'s return run but went on to botanize in Java before making his own way back to France in 1807. His remarks on the Australian flora were printed in Péron and Freycinet (1816: 358-372). During the Australian voyage Leschenault de la Tour, of necessity, was committed to botany but later, in the years 1816-21 of travel in India and Ceylon, he envinced notable talent as an observer and collector of minerals (Holland, 1900). And unlike the Baudin expedition's mineral collections from Australia, his from India and Ceylon were studied in some detail, by Bournon (1823) and others later, and remain, I believe, in the Paris *Muséum d'Histoire Naturelle*.

élève 2. Jacques DELISSE — no biography found

Another *élève* at the *Muséum*, and a student of botany for two years (Cornell, 1965: 57), Delisse was attached to the *Naturaliste* on the voyage from France. Claiming ill-health, he withdrew at Mauritius in 1801. His chemical study of water at Mauritius is mentioned by Péron (1807: 54). Péron there refers to him as 'Deslisse', the form also used by Bory de St Vincent (1805). Delisse was still at Mauritius when Bory left for France in March 1803 but expected soon to follow.

MINERALOGISTS

1. Louis DEPUCH [d. February (?) 1803] — no biography found

From Jonzac in the Charente-Maritime, Depuch (according to Buch, 1814) was educated at the *École des Mines*, Paris, and had been a student of Haüy. Presumably Haüy, already a member of the *Institut National*, recommended him to the *Institut*'s expedition advisory commission. Depuch took a prominent part in the scientific effort (passages from his notes are quoted in Baudin (1974), and in Péron (1807)) during the voyage of the *Géographe* until he became weakened by dysentery at Timor (Sept. 1801). He continued to perform what duty he could but at the end of the stay at Port Jackson (Nov. 1802) Baudin transferred him to the *Naturaliste* for earlier return home. The commander's many kindly, if at times exasperated, remarks about Depuch and the arrangements made to provide the invalid with fresh food (Baudin, 1974: 441) show the claim about by Péron (1807: 445) that Baudin acted spitefully towards Depuch is a lie. On reaching Mauritius (Feb. 1803) Depuch was too debilitated to go further. He was taken ashore and died there, according to one source (Péron and Freycinet, 1816: xxvii) after a few days, or some months (Jussieu, 1804: 4). Strangely, Bory de St Vincent (1805) makes no mention of the *Naturaliste*'s call though he was on the island at the time. Attempts to trace a record of Depuch's death have been unsuccessful.

2. (*aide-minéralogiste*) Joseph Charles BAILLY [1777-1844] — *Dict. Biogr. Franç.* 4: col. 1355

Born at Nancy, Bailly had just completed studies at the Paris *École Polytechnique* when in June 1800 he was appointed to the expedition. Attached to the *Naturaliste*, Bailly transferred at Sydney to Depuch's place on the *Géographe* and returned to France (March 1804) with that vessel. Buch (1814), mistakenly, claimed he went off to Java with Leschenault de la Tour; the error suggests remarkable ignorance or lack of concern among Buch's informants. Yet on the voyage Bailly had been an active participant. His notes, as Depuch's, were extensively quarried for the official record (Péron, 1807; Péron and Freycinet, 1816). Most of the surviving unpublished catalogue of Australian rocks and minerals seems to be the work of Bailly, and to have been prepared in Sydney. Although only he and Péron, of all Baudin's scientists, returned with the expedition, Bailly was given no opportunity to work up the mineralogical results. Jussieu's (1804: 7) dismissive view of the mineralogists' achievement and the myopic *Rapport* of Cuvier (Péron, 1807: I-XV) that found merit only in zoology (and hence employment for Péron), betokened the lack of any powerful interest in the rock and mineral collections. Fortunately, Bailly had done some hydrographic work during the voyage. In 1806 he joined the French hydrographic service and there followed a distinguished career under C. F. Beautemps-Beaupré [1766-1854], himself a veteran of Australian survey under Bruni d'Entrecasteaux.

ZOOLOGISTS

1. René MAUGÉ [d. 20 February 1802] — no biography found

Maugé was an *aide-naturaliste* at the Paris *Muséum* when appointed first zoologist to the Australian expedition. He had already sailed with Baudin to the West Indies (1796-8) and remained his friend on the *Géographe*. Like Depuch, Maugé fell victim to dysentery at Timor. His death, at Maria Island (Tasmania) was a bitter blow to the commander who remarked in his *Journal*: 'This naturalist did not have the title of scientist, but, alone, he did more than all the scientists put together' (Baudin, 1974: 340). Maugé, as first zoologist, surely had scientific rank. Perhaps Baudin meant to distinguish him from the sometimes, and in Péron's case probably always, difficult younger men from the higher *Écoles*. Baudin's estimate of his first zoologist's scientific work is not matched by Péron's acknowledgement of his senior colleague. Yet Baudin's praise was not eccentric. Maugé, '*cet homme estimable*', is even lauded as a mineral collector in Lucas (1813: 102).

2. Jean Baptiste Georges Marie BORY DE SAINT VINCENT [1778-1846] — *Dict. Sci. Biogr.* 2: 321

Bory de St Vincent early became interested in the fauna and flora of his native Guyenne and while still a youth began corresponding with established naturalists. Conscripted into the army in 1799, the next year he was seconded to the Baudin expedition, as second zoologist, on the recommendation of Bernard de Lacépède who thought him versed in zoological book-learning (Cornell, 1965: 58). Although Bory travelled on the *Naturaliste* he took a vehement dislike to Baudin and withdrew at Mauritius (1801), claiming fragile health. There and on Réunion Bory busied himself as a private naturalist until he returned to France (July 1803) and resumed military service. His account of the voyage under Baudin and the sojourn in the Mascarene islands (Bory de St Vincent, 1805) is marred by a sustained attempt to depreciate and ridicule the commander. The scientific work for which Bory is remembered belonged, for the most part, to his later years.

élève 1. Désiré DUMONT — no biography found

According to Cornell (1965: 58) Dumont had been recommended by Maugé and other *aides* at the *Muséum* as preparator of animal specimens on the expedition. Dumont was said to be a good hunter, of robust health and able to bear fatigue. Nevertheless he withdrew from the *Naturaliste* at Mauritius, pleading ill-health. In his records of physical performance Péron (1807: 482) notes Dumont as 'surgeon' and Bory de St Vincent (1805: 66) claims he sought a surgeon's place for Dumont at Mauritius, by way of refuting the charge that his friend had left to join a wealthy brother on the island. Bory adds that Dumont was then 'turned of twenty-eight' and no conscript to military service. Dumont was still on Mauritius when Bory departed in March 1803.

élève 2. Stanislas LEVILLAIN [d. 22/23 December 1801] — no biography found

Levillain, from Le Havre, had sailed with Baudin to the West Indies and distinguished himself as a collector and student of animals, in particular of insects. At first attached to the *Géographe*, Levillain was moved at Mauritius to the *Naturaliste* which had lost by defection or other reason all except Bailly of its naturalists. Levillain became another victim of dysentery during the 1801 visit to Timor. At sea early 23 December 1801 Baudin received a signal from the *Naturaliste* advising Levillain had died (Baudin, 1974: 288). The date (29 Dec.) given by Péron and Freycinet (1816: xxvii) is wrong; that offered by Wallace (1984: appendix) is an invention.

élève 3. François PÉRON [1775-1810] — *Dict. Sci. Biogr.* 10: 517-8; *Dict. Austr. Biogr.* 2: 323-4 (but neither entirely reliable)

'As there is now a vacancy through the resignation of one of the naturalists, the commission proposes to substitute, on the request of Cuvier, a student of the *École de Santé* called Péron' (Wallace, 1984: 30). So Jussieu, on behalf of the advisory commission, informed the Navy minister by letter 7 August 1800. The proposal, quickly approved, was that Péron should join as third *élève* zoologist with a responsibility for Cuvier's special field, comparative anatomy. Travelling throughout on the *Géographe*, Péron alone of the zoologists completed the voyage. On his return to Paris, with Cuvier's powerful support and with Bailly cast aside, Péron became official recorder of the expedition. He only of the scientific travellers was granted the means to develop the expedition's results. Péron (1807) and its sequel are, of course, major sources but their partisan character, especially in regard to Péron's shameless self-glorification and his unrelieved denigration of the commander, cannot be ignored. Dunmore (1969: 11), indeed, warns that 'Péron's reliability is limited to scientific subjects'. Yet even on that score opinions differ. Those who accept Péron on his terms consider him a hero (e.g. Wallace, 1984); others, more critical, even find aspects of his science defective (e.g. Moore in Degérando, 1969). Péron's ambition and zeal for science are undoubted; he had talent but, sadly, he was also an intriguer, a liar and a spy. His legacy is a still-unravelled web of science and politics. How differently Ledru (1810) dealt with Baudin's scientific voyage to the West Indies.